Dupage Salt Creek Workgroup POTW Special Condition Holder Forum

February 1, 2018

BAXTER & WOODMAN Consulting Engineers

AGENDA

- **Why Studies Were Done**
- **What Studies We Did**
- **Study Approach**
- **Results**
- **Next Steps**

Reasons for Total Phosphorus Studies

- **NPDES Permit Compliance**
  - Special Condition 18
    - Negotiated by DuPage River Salt Creek Workgroup (DRSCW)
  - Phosphorus
    - Discharge Optimization Plan
    - Feasibility Study
    - Nutrient Implementation Plan (by DRSCW)

BWI Studies Performed

- Downers Grove Sanitary District
- Village of Hanover Park
- Village of Bloomingdale
- Glenbard Wastewater Authority
- Fox River Grove
- City of Belvidere (on-going)
- Village of Frankfort (on-going)
- Lots of Others

Study Overview: Two Parts

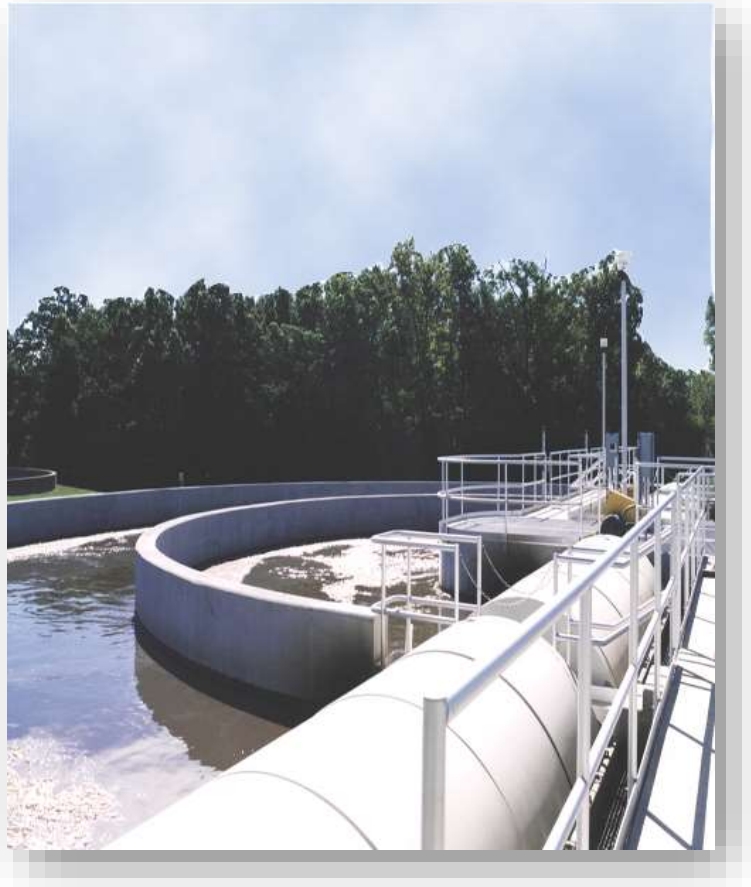
Meeting the Goals and Requirements of the NDPES Permits

- **Phosphorus Discharge Optimization Plan**
  - Influent reduction measures
    - Source Control
  - Effluent reduction measures
    - "Low or No Cost" Plant Modifications
- **Phosphorus Feasibility Study**
  - Bio-P, Chem-P, & Combination
  - 1.0, 0.5, and 0.1 mg/L limits

Study Approach: Tasks

Three Major Tasks:

1. Influent Reduction Measures
2. Feasibility Study
3. Effluent Reduction Measures



Study Approach: Influent Reduction Measures

- **Focused Phosphorus Survey**
  - Industrial, Residential, Commercial?
  - Existing survey data
- **Targeted Site Inspections and Sampling**
- **Source and Load Estimations**
- **Follow Up With Selected Phosphorus Users**

Influent Reduction Measures: Results

Results

1. Industrial sources of phosphorus are not a typically a problem..at least when achieving effluent limit 0.5 mg/l.
   - Even with some higher discharge levels of phosphorus, dilution helps.

2. Some WWTP's might have an industrial source issue if required to reduce effluent TP down to 0.1 mg/l….hard to say.

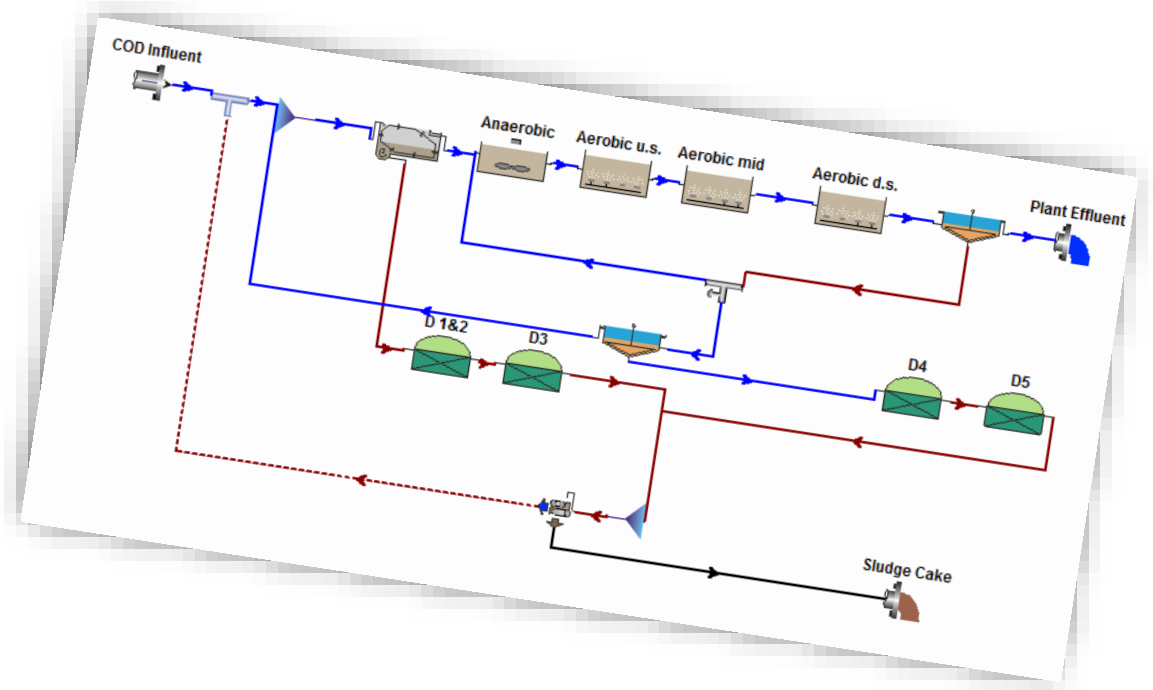
3. Municipalities are not eager to push away industries at this time.

4. Good chance to review dischargers to collection system.

Study Approach: Feasibility Study

Feasibility Study Done First: Bio-P Evaluation

- Influent sampling of rbCOD (and for SNRP):
  - Determine Bio-P potential.
  - Ability to achieve low effluent limits due to Soluble Non-Reactive P.
- WWTP Biowin modeling, simply calibrated as best able with past process data.
- Looked at both total phosphorus and total nitrogen limits.
- Assess availability of VFA's to drive Bio-P.
- Need effluent reduction to "land" below limits to be considered effective.



Study Approach: Feasibility Study

Feasibility Study Done: Bio-P Evaluation

Typical Bio-P A/S Process Modifications:

- Various Anaerobic Zone/Anoxic Zone/Aeration Zone Arrangements
- Typically based on need to ferment VFA's and/or reduce RAS nitrate.

Typical Equipment Required:

- Mixers for Anaerobic and Anoxic Zones
- Mixed Liquor Recycle Pump and Piping
- Baffles Walls
- New aeration diffusers
- Process instrumentation.

Feasibility Study: Results

Bio-P Evaluation Results:

1. Some WWTP's had sufficient rbCOD, some did not. Not sure why…..

2. SNRP was higher than effluent limit of 0.1 mg/l in many cases.
    1. Could be a big problem….no easy way to remove.

3. Oxidation ditches present a special problem for bio-P due to inability to create/control process zones easily. Also, not easy to model.
    - But empirical data from Wisconsin suggest some oxidation ditches perform bio-P just fine?

4. Biosolids recycle streams and secondary P release are a BIG problem for Bio-P removal.

Feasibility Study: Results

Bio-P Evaluation Results:

Some noted biosolids recycle streams and secondary P release sources:

- Long term liquid sludge storage in underground tank with supernatant and filtrate return.

- Two stage aerobic digestion with cyclic aeration: Anaerobic/anoxic conditions released soluble phosphorus from WAS and was recycled back into aeration basins.

- Typical anaerobic digester supernatant and dewatering recycle.

Feasibility Study: Results

Feasibility Study: Chemical P Removal

- *Conceptual Design and Cost Provided In All Studies*
  - Feasible Solution for TP Reduction Down to 0.5 mg/l.

- *Chemical P Facility ranges from $300,000 to* $600,000 depending on new facilities required.
  - Chemical P "polishing" upstream of tertiary filtration required once at 1.0 mg/l to consistently achieve 0.1 mg/l.

- *Annual costs for Chemical P addition (chemicals and sludge)*:
  - From $100k to $200k for achieving 1.0 mg/l TP.
  - Additional $50K to reduce further to 0.5 mg/l.
  - Additional $40K to reduce further to 0.1 mg/l

Feasibility Study: Results

General Feasibility Evaluation Results:

1. *Few plants could "clearly" achieve consistent Bio-P down to 1.0 mg/l*
   - Activated sludge system could be modified (for a price) for Bio-P removal but biosolids recycle streams and secondary release overwhelmed the P removal capability with "available VFA's".
   - Often required carbon supplementation----$$$$.

2. *Most plants recommended to install chemical P removal to achieve effluent to 0.5 mg/l.*
   - Additional sludge production is a concern which may push some plants into additional costs for dewatering and/or site storage.
   - Additional sludge storage on-site could get REALLY expensive if 180 storage required

Feasibility Study Results

General Feasibility Study Results:

1. *For those plants with "achievable" Bio-P, ammonia removal down to predicted new levels not an issue*
   - One plant with pure oxygen A/S might have an ammonia reduction issue without additional tankage.

2. *One facility recommended to attempt "side-stream" chemical P removal to bind up soluble phosphorus and reduce load on A/S Bio-P main-line treatment.*
   - Still a $6M capital project for 1.0 mg/l TP reduction.

3. *Tertiary filtration definitely recommended for 0.1 mg/l limit or if 0.5 mg/l limit was required with frequent monitoring schedule.*
   - Estimated $7,000,000 for one WWTP.

Feasibility Study Results

Feasibility Study Results: **Monitoring Frequency:**

- 1.0 mg/l: Monthly monitoring frequency minimum.
- 0.5 mg/l: Seasonal to annual monitoring frequency. Monthly COULD be acceptable if facility already has tertiary filters.
- 0.1 mg/l: NO LESS than seasonal or annual monitoring.

Phosphorus Study Conclusions

Influent Reduction Measures:

- Industrial sources of phosphorus very low and dilution does not make them a major factor.

Feasibility Study Results:

- Consistent Bio-P down past 1.0 mg/l not a “slam dunk” in any study.
  - Definitely possible at various locations with substantial capital investment for mixers, additional tanks, carbon, etc.
- P recycles from biosolids process are a major problem limiting Bio-P.
- Chemical P still required as back-up down to 0.5 mg/l.
- Consistently achieving effluent limit of 0.1 mg/l very expensive and resource intensive.

Optimization Plans:

- Typically try to facilitate Bio-P with existing infrastructure.

Study Approach: Questions?

Thank you!

Phosphorus Feasibility Study

1.0 mg/L

Monthly	Seasonal	Annual
B C X	B C X	B C X
1 2 3	4 5 6	7 8 9

9 Alternatives

0.5 mg/L

Monthly	Seasonal	Annual
B C X	B C X	B C X
1 2 3	4 5 6	7 8 9

9 Alternatives

0.1 mg/L

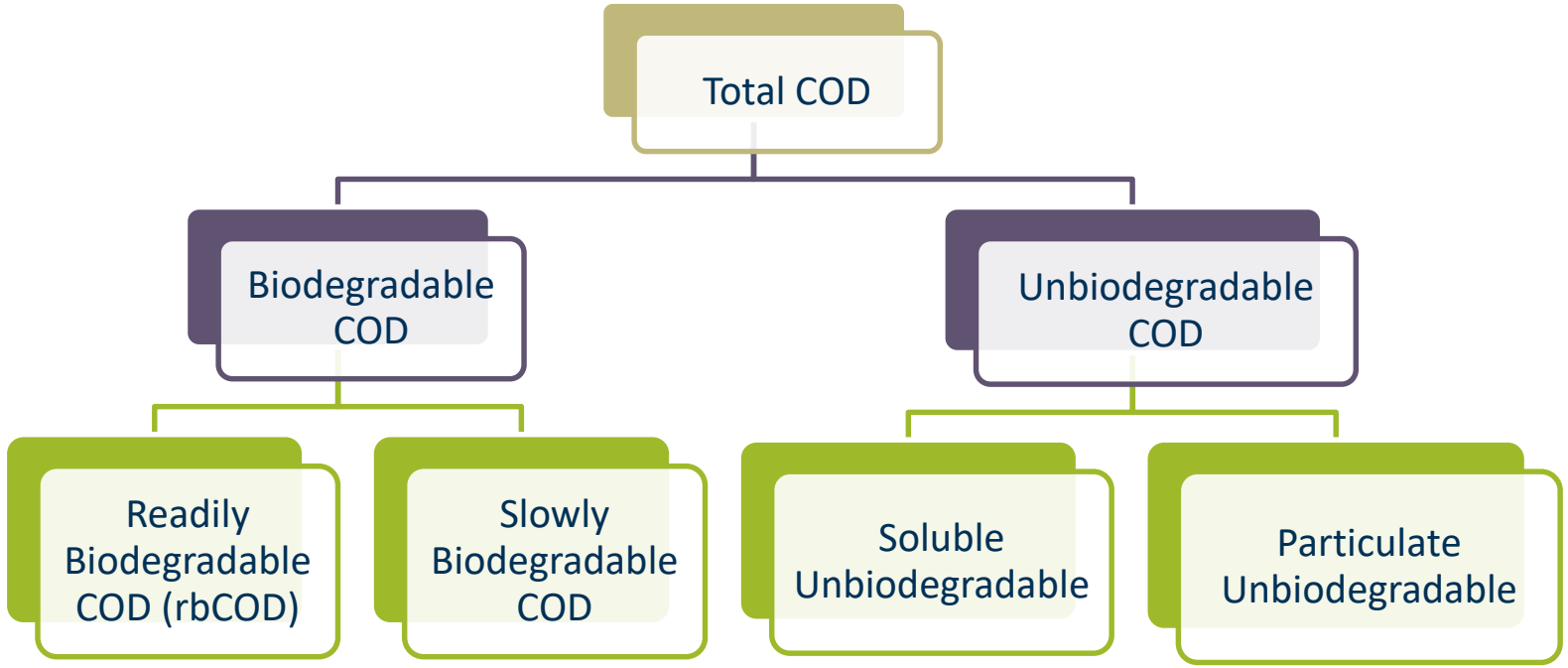
Monthly	Seasonal	Annual
B C X	B C X	B C X
1 2 3	4 5 6	7 8 9

9 Alternatives

Total: 27 Alternatives

Biological Phosphorus Removal Evaluations

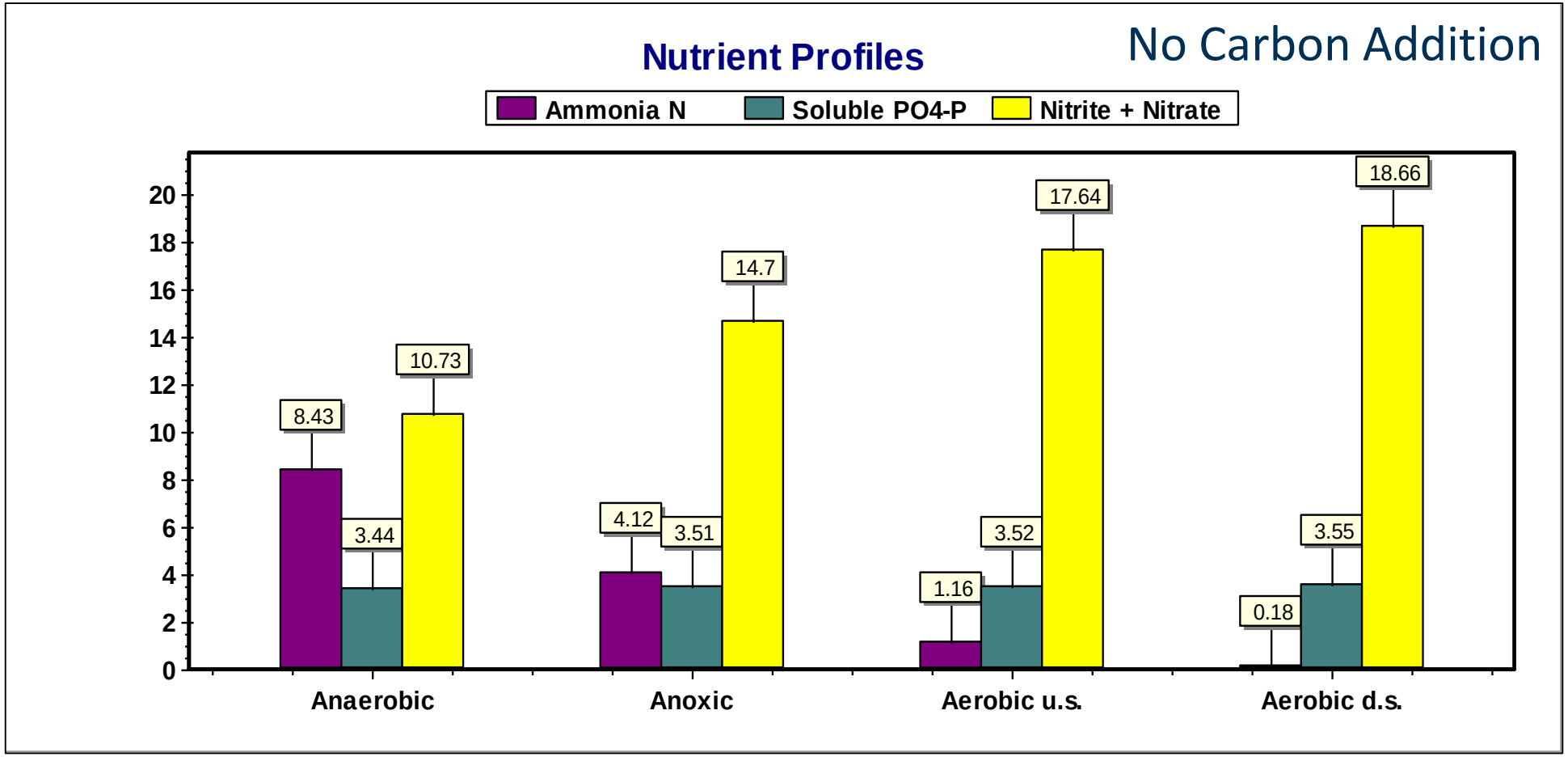
- **Garbage in = Garbage out**



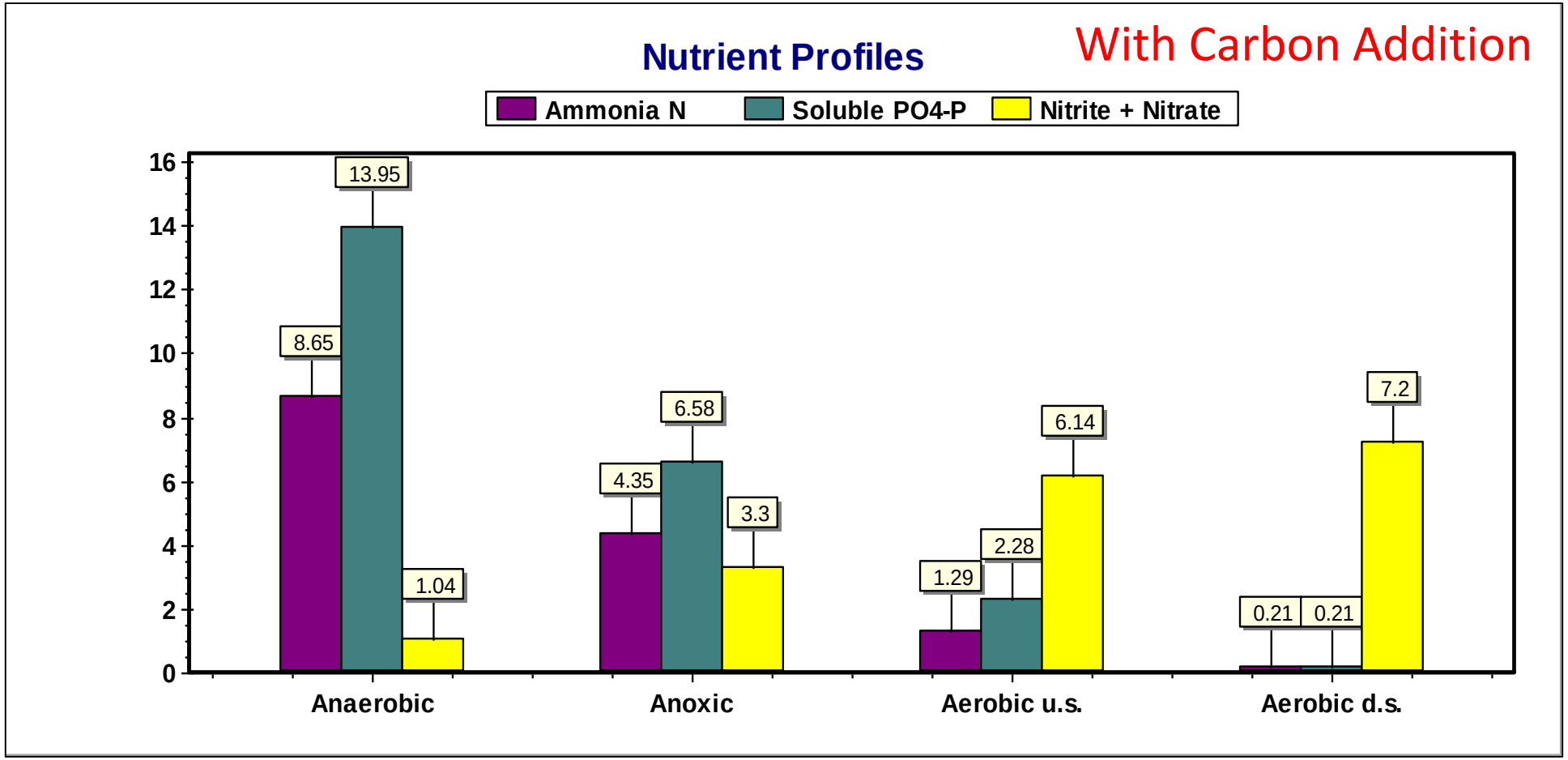
Chemical Phosphorus Removal

Chemical & Biological Phosphorus Removal Comparison		
	Chemical P Removal	**Biological P Removal with Chemical Back-Up**
Capital Cost	Low	Moderate to High
O&M Cost	Low	Moderate
Cost of Chemicals	High	Low
Biosolids Quantity	High	Low
Operation	Simple	Moderate
Sustainability	Low	High
Retrofit to Existing Plant	Simple	Moderate to Complex
Reliability	High	High with chemical back-up

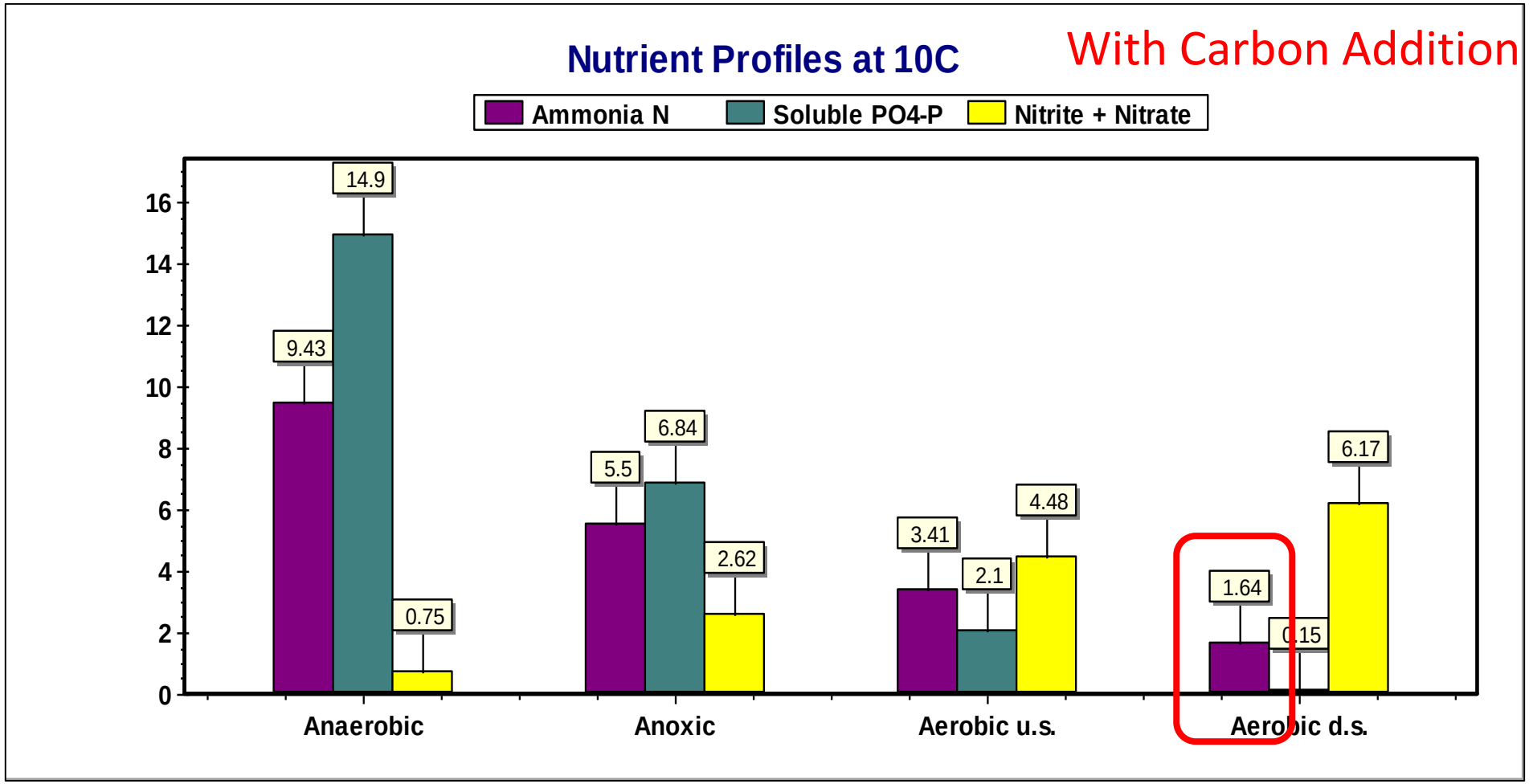
Biological Phosphorus Removal



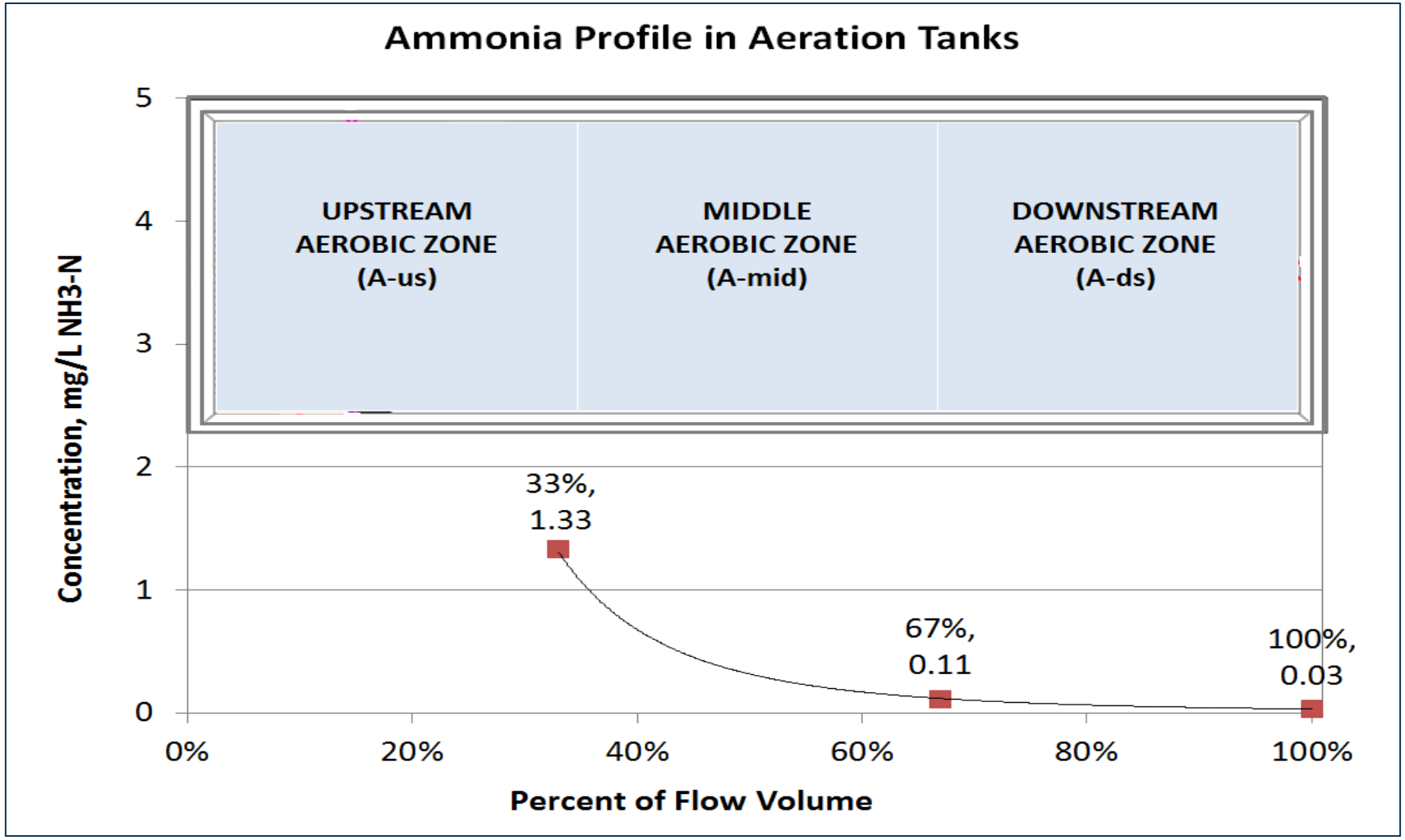
Biological Phosphorus Removal



Biological Phosphorus Removal



Biological Phosphorus Removal



Biological Phosphorus Removal